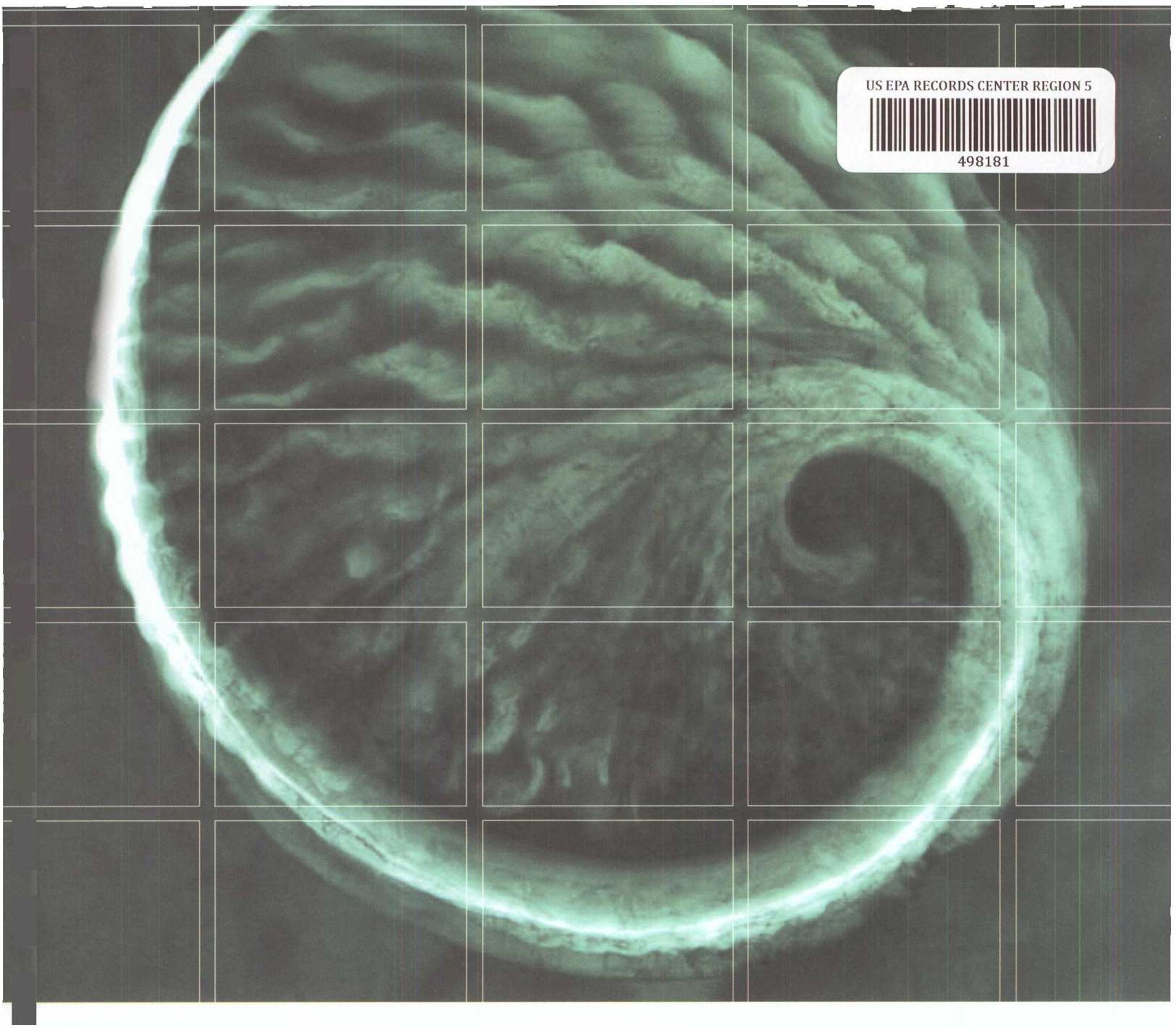

Sampling and Analysis Plan

Greiner's Lagoon – Fremont, Ohio

June 2005

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Sampling and Analysis Plan:
Griener's Lagoon- Fremont, Ohio

June 2005

Project No. 0004100

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1.0 INTRODUCTION

The Greiner's Lagoon site is located south of Fremont, Ohio on County Road 181 about 1/2 mile west of Tiffin Road in Ballville Township, Sandusky County (Figure 1). The Site was originally developed by Mr. Terry Little in 1954 and consisted of four lagoons to store waste oil from nearby industry. After several changes in ownership, the Site was purchased by Mr. Gary Greiner in 1973. During the course of Site operations by the various owners, a number of community complaints and legal actions were undertaken because of odors and releases from the lagoons. In 1980, a judgment handed down by the Sandusky Court of Common Pleas ordered Mr. Greiner to clean up the Site. He did not comply with the order.

In 1981, 1982 and 1986-1988, United States Environmental Protection Agency (USEPA) implemented Site removal actions including lagoon dike reinforcement, surface oil removal, liquids treatment and discharge, sludge solidification, lagoon backfilling, and placement of a soil cover over the filled lagoons. Between 1982 and 1985, Ohio EPA coordinated the delivery of sand and gravel washings from the processing of sugar beets and placement of the material in the open lagoons.

On July 30, 1991, the Lubrizol Corporation (Lubrizol) entered into an Administrative Order by Consent (AOC) with USEPA Region V pursuant to Section 106 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) to undertake actions to produce an Engineering Evaluation/Cost Analysis (EE/CA) for the Greiner's Lagoon Site in Sandusky County, Ohio. The September 2000 EE/CA identified and evaluated several alternatives for a non-time critical removal action at the Site. One of these alternatives was the use of a technology known as phytoremediation. Phytoremediation is the use of plants to prevent soil erosion, remove excess water, and promote remediation of constituents in soil and/or ground water. This alternative was selected as the preferred alternative for the Greiner's Lagoon Site. Construction / implementation of the phytoremediation alternative is scheduled to begin in mid 2005.

This Sampling and Analysis Plan (Plan) specifies the parameters and frequencies for groundwater analysis of each of the monitoring wells identified at the site and details the equipment and procedures which will be utilized to collect, transport, and analyze groundwater samples, and evaluate the data generated from sampling at the site.

2.0 GEOLOGIC AND HYDROGEOLOGIC SETTING

The September 2000 EE/CA provides a detailed description of the geologic and hydrogeologic conditions at the site. The following sections provide a brief summary of the information provided in that report.

2.1 REGIONAL AND SITE SPECIFIC GEOLOGY

Based on a review of local geologic maps and United States Geological Survey (USGS) data and drilling observations, the shallow Site stratigraphy consists primarily of glacial and alluvial deposits made of interbedded sands, silts, and clays. These deposits locally vary in thickness from 20 to 50 feet below ground surface (bgs). The Site specific unconsolidated deposits were approximately 35 feet thick above the bedrock. Generally the upper 8 through 10 feet of the naturally occurring deposits (ouside the lagoon area) consist of either silty sand, sand, or silty clay. Depths greater than 8 to 10 feet bgs consist primarily of silty clay or clay. This clay/silty clay, which is approximately 25 feet thick, acts as a confining unit for the regional bedrock aquifer.

Bedrock encountered at the Site consists of the Lockport Dolomite which was deposited during the Silurian Period. The bedrock was encountered at a depth of approximately 35 feet bgs. The Lockport Dolomite composes the eastern flank of the Findlay Arch which is a prominent bedrock anticlinal structure in northwestern Ohio. The anticlinal structure exposes older units on the crest of the arch and successively younger bedrock units to the east and west.

2.2 REGIONAL AND SITE SPECIFIC HYDROGEOLOGY

The principal aquifer system in the northwest Ohio region is contained within the carbonate bedrock units that compose the Findlay Arch. At the subject Site, the primary aquifer lies within the Lockport Dolomite. As with most carbonate rocks, the ground water principally flows through secondary porosity such as fractures, along bedding planes, and through solution channels. Well yields are attributable to the degree of penetration into interconnected fractures or solution channels within the aquifer. The average yield of the Lockport Dolomite is 100 gallons per minute.

Ground water elevation data demonstrate that the ground water surface in the bedrock aquifer monitoring wells (MW-1, MW-2, and MW-3) is

approximately 20 feet below ground surface. The depth to bedrock, however, is at a greater depth of approximately 35 feet below ground surface. The actual ground water surface in the primary regional aquifer is within this bedrock. The elevated ground water surface above the depth to bedrock in the monitoring wells suggests that the primary regional aquifer is under confined conditions. This could be attributed to the clay/silty clay overlying the bedrock at the site. The clay/silty clay overlying the bedrock isolates the ground water in the bedrock from the atmosphere, therefore the bedrock aquifer is generally subjected to pressures higher than atmospheric pressure. The water levels in the bedrock wells represent the confining pressure at the top of the bedrock aquifer. The elevation to which water rises in a well that is installed into a confined aquifer is called its potentiometric level.

Figure 2 presents the groundwater flow in the bedrock aquifer for April 1999. The bedrock monitoring wells indicate that the localized flow direction of the regional aquifer is toward the east-northeast with a hydraulic gradient ranging from 0.0003 to 0.00007 ft/ft and an average hydraulic gradient of 0.0004 ft/ft.

Figure 3 presents the flow of groundwater in the shallow saturated zone for April 1999. The shallow monitoring wells indicate that the localized flow direction of the shallow saturated zone is generally toward the northwest, west and southwest with a hydraulic gradient ranging from 0.0005 to 0.0125 ft/ft and an average hydraulic gradient of 0.008 ft/ft. Accordingly, these data demonstrate a general flow direction that radiates away from the drainage ditch on the northeastern end of the site. This suggests that the drainage ditch could be a recharge point from surface water runoff.

The shallow saturated zone is not used for potable purposes due to its low yield. The higher yielding bedrock aquifer is at a depth of approximately 30 feet. The Ohio Department of Health requiring that water well depths must be > 25 feet below ground surface.

As indicated on the ODNR well logs and the ERM-prepared soil boring/well logs (Appendix A), the subsurface geology consists of a clay/silty clay unit (> 20 feet thick) between the shallow saturated zone and the bedrock aquifer. Based on the presence of this clay unit, and the differences in water level data and the differences in hydraulic gradient between the two units, the shallow saturated zone and bedrock aquifer are not connected.

3.0 GROUNDWATER MONITORING SYSTEM

A total of 14 monitoring wells have been installed in and surrounding the site (Figure 4). Three wells (MW-1, -2, and -3) are located in the bedrock zone. The remaining wells (MW-4, -5, -6, -7, -8, -9, -10, -11, -12, -13, and -14) are located in the shallow saturated zone. The placement of these monitor wells was based on information obtained during the hydrogeologic investigation. The wells were placed to enable representative monitoring of both the upgradient and downgradient water quality.

One additional monitoring well is proposed to be installed in the shallow saturation zone to the east of existing well MW-13, previously installed in the shallow saturated zone, to allow for further characterization of groundwater quality in this area. This additional well will be installed before groundwater sampling activities are initiated in accordance with this Sampling and Analysis Plan.

This Plan incorporates the 14 existing wells and the proposed additional monitoring well to be installed east of MW-13. Table 1 summarizes the dates of installation, elevations and depths, and description of the screened interval.

3.1 EXISTING MONITORING WELL CONSTRUCTION / DEVELOPMENT DETAILS

Each of the monitoring wells was designed, installed, and developed in a manner that allows for the collection of groundwater samples that are representative of groundwater quality in the geologic unit being monitored. Well construction details are discussed in greater detail within the EE/CA. Boring logs and well construction diagrams are included in Appendix A.

3.2 MONITORING WELL INSTALLATION PROCEDURES

One additional monitoring well is currently scheduled to be installed at a location east of MW-13. This well and any additional monitoring wells installed at the site will follow the well installation procedures detailed in this section.

Prior to drilling, the drilling rig, associated tools, and all down hole equipment will be cleaned with a high-pressure, high-temperature wash. All of the decontamination will be done onsite under the supervision of the project geologist. The decontamination water will not be containerized.

The borings for any additional monitor wells will be continuously sampled from the ground surface to the completion depth. The boring will be sampled through 4.25-inch inside diameter (ID) hollow stem augers with either a split-spoon sampler or a 5-foot continuous sampler. When the split-spoon sampler is utilized, it will be driven by a standard 140-pound hammer with a 30-inch free fall. The soil types, depths, consistencies, and blow counts will be logged by the project geologist for each sampling interval. Introduction of foreign water will be minimal and will take place only under the direction of the project geologist.

The monitor well will be installed through the 4.25-inch ID hollow stem augers. The well will be constructed from 2-inch inside diameter, schedule 40 PVC casing with a 10-foot long, 0.01-inch machine slotted screen. The bottom of each well screen will be fitted with a cap.

Once the desired monitoring depth is reached, the well screen and casing will be set in place. A filter pack consisting of clean quartz sand will then be emplaced around the screen by slowly adding sand into the annular space. The sand pack will not extend more than 2 feet above the top and bottom of the screen.

A 2- to 3-foot bentonite seal will be emplaced above the sand pack in order to seal the annular space. Bentonite slurry will be injected through a Tremie pipe into the remaining annular space above the bentonite pack. A 6-inch diameter, locking protector pipe will be installed into a concrete anchor/pad at the surface. The concrete anchor will extend at least 3 feet below the ground surface and will slope away from the well to promote drainage away from the wellhead. To prevent water accumulation inside of the protector pipe, 12 inches of pea gravel will be placed inside the protector pipe and drain holes will be drilled near the base of the pipe.

The monitor well will be developed using a surge block, stainless steel bailer, or small-diameter submersible pump. Water in the well will be surged in order to remove fine sand, silt, and clay from the area surrounding the well screen. New monitoring wells will be developed until the field parameters of pH, specific conductance, temperature and turbidity have stabilized for three consecutive readings or until 10 well volumes have been removed. All development equipment will be washed with a laboratory grade soap followed by a triple deionized water rinse

prior to development of the well. All water removed from the monitor well during development will be disposed of away from the well head.

All future monitor well logs for additional monitor wells that are installed will be supplied to the USEPA, the Ohio EPA, the County Health Department, and the Ohio Department of Natural Resources (ODNR)-Division of Water

3.3 *MONITORING WELL ABANDONMENT PROCEDURES*

Lubrizol may propose to abandon wells that are not needed for groundwater monitoring. None of the wells will be abandoned without prior approval from USEPA.

Wells to be abandoned will be physically removed from the substrate by overdrilling with 4.25-inch ID hollow stem augers until the casing and screen assembly can be removed using the hydraulic lift or winch of the drill rig. The original drill hole will be drilled out to the depth reported in the log. Once the well assembly has been removed from the borehole and the augers advanced to the original boring depth, the hole will be pressure grouted to the surface with bentonite slurry injected through a Tremie pipe.

An ODNR Water Well Sealing Report will be completed for all well abandonments and will be supplied to the USEPA, the Ohio EPA, the County Health Department, and the ODNR-Division of Water.

4.0 SAMPLING AND ANALYSIS

This section describes the equipment and procedures that will be used during groundwater monitoring and analysis at the site. Each aspect of the sampling program, from measurements of groundwater elevation data to sample collection, to laboratory analysis, are discussed in detail in the sections to follow.

4.1 SAMPLING PARAMETERS AND FREQUENCY

Groundwater samples will be collected on an annual basis during the third quarter (i.e., July, August or September)of each year. Groundwater samples will be collected and analyzed for VOCs, sVOCs, and Priortiy Pollutant Metals.

4.2 MONITORING WELL INSPECTION AND MAINTENANCE

The integrity of all monitor wells will be inspected during each sampling event. During each inspection, the sampling technician will note on a Groundwater Sampling Field Data Sheet (example included in Appendix B) whether:

- The well number is clearly labeled on the outer casing or lid;
- The protective casing is in good condition;
- The weep hole adequately drains the outer protective casing;
- The concrete pad is intact and not damaged by heaving or excessive cracking;
- The padlock is functional;
- The inner casing is intact; and
- The inner casing is properly capped.

In the event that damage or excessive wear is observed, attempts to repair the well will be made. Lubrizol will be notified immediately of any conditions that would prevent, or preclude sampling or affect sample integrity. Lubrizol will be notified of required maintenance and the

sampling team will follow up to ensure that the maintenance is completed. Completed well maintenance activities will be documented and documentation supplied to the USEPA and Ohio EPA.

If the well cannot be readily repaired and the condition of the well jeopardizes the integrity of groundwater samples or water level measurements, the well will be properly abandoned and replaced. Abandonment and well installation and construction procedures are discussed in a previous section. Monitor wells will not be abandoned or replaced without prior approval from the USEPA.

The degree of turbidity in each well will be evaluated during each sampling event to determine if redevelopment of the well is necessary. Wells which are screened in fine-grained material are susceptible to "silting". In the event that excessive turbidity (>1000 NTU) prohibits the collection of a representative groundwater sample, the well will be redeveloped. If the redevelopment is successful the well will then be sampled within 48 hours of development. In the event that the redevelopment is not successful the need for a replacement well will be evaluated. Redevelopment will be completed using a procedure similar to that described below.

Fine-grained material at the bottom of the well will be removed with a stainless steel bailer or sand pump. The well may then be pumped to remove fine-grained material immediately surrounding the well screen. The pump may be periodically turned off and on (or the flow rate significantly increased and decreased) to surge water through the well screen. A surge block may then be run up and down the cased section of the well. Initial surging will be relatively gently and will allow material blocking the screen to break up and enter the well. As water begins to move through the well screen more readily, the surge block will be lowered in steps to just above the well screen. The surge block will not be lowered into the screen of the well in order to prevent potential damage to the screen. Surging will be continued for several minutes, if possible, before removing the surge block from the well. Materials that have accumulated at the bottom of the well will then be removed with the bailer or sand pump. This series of bailing, pumping, surging, and bailing will be repeated until little or no fine-grained sediment can be pulled into the well. It may not be possible to remove all fine sediment from a well screened in a fine-grained material.

4.3 GROUNDWATER SAMPLE COLLECTION

4.3.1 Site Contact and Access

Site Contact:	Lubrizol Project Coordinator
Notification Requirements:	EPA will be notified not less than 14 days in advance of any sample collection activity.

4.3.2 Field Records

As part of the sampling program at the site, a detailed field data sheet for each well will be maintained by sampling personnel. Individual field data sheets for each monitor well will be completed during each sampling event. An example of the standardized groundwater sampling field data sheet is included in Appendix B. The individual field data sheets will document the following:

- Identification of well and well depth;
- Static water level and measurement technique;
- Presence, and thickness (if any), of immiscible layers and detection method;
- Well yield (high or low);
- Time well was purged, purge volume, and rate;
- Measured field parameters (pH, specific conductance, temperature, and turbidity);
- Collection method for immiscible layers and sample identification numbers (if applicable);
- Well evacuation and sampling equipment;
- Well sampling sequence (as noted by sample times on forms);
- Type of containers and sample identification;
- Preservative(s) used;
- Field analysis data and methods;

- Field observations during sampling event;
- Name of collector(s);
- Climatic conditions including air temperature;
- Sample appearance: color, turbidity, odor, etc., (if any);
- Any evidence of tampering or damage to the well or lock; and,
- Any problems encountered or deviations from this plan.

4.3.3 *Groundwater level measuresments*

Before the wells are purged, prior to sampling, the water level in each of the wells will be measured to within an accuracy of 0.01 foot with an electronic water level probe. Water level measurements will be recorded beginning with the upgradient wells first. The water level probe tip (i.e., the portion that comes into contact with the water in the well) will be rinsed with deionized water prior to and after each water level measurement. A complete circuit of groundwater measurements will be made in a minimal amount of time in order to minimize the effects of barometric pressure fluctuations (not to exceed 24 hours). See Section 4.5 for decontamination procedures of the entire length of water level probe and tape that comes into contact with the water in the well if the total depth of the well is measured.

Reference points will be marked at the top of PVC casings. The elevation of the reference point have been/will be determined by a licensed surveyor. Groundwater levels will be measured relative to this reference point.

All observations and data will be recorded on the field data sheets. The groundwater elevations will be used to produce potentiometric surface maps for each of the monitored units during each sampling event. The flow directions will be evaluated to determine if changes to the monitoring system are needed.

4.3.4 *Well Purging*

Prior to sampling, the wells will be purged using disposable bailers. Stagnant water in each well casing will be removed to ensure that the sample is representative of actual groundwater quality. Wells will be purged to dryness (low yield wells) or purged of three volumes. The

volume of water to be removed from each well will be calculated in the field by using the following formula:

$V = (pi)(r^2)(h)(7.48)$

where: pi =3.1415

V = one well volume (gallons)

r = well radius in feet (1 inch = 0.083 feet)

h = height of water inside the well casing (feet)

7.48 = factor for converting cubic feet to gallons

Thus, in a 2-inch diameter well, there will be 0.168 gallon per foot of storage in the well. The volume of standing water will be determined by subtracting the depth to water from the total well depth and multiplying the result by the constant (0.168).

As a check on purging efficiency, the pH, conductivity, and temperature of the groundwater will be measured and noted on the field data sheets at least three times during purging. In wells where three or more well volumes will be removed, if the variation between the last two measurements is greater than 10% after purging three well volumes, additional water will be purged up to a maximum of five times the volume of water in the well casing and volume of the sand pack. The sand pack volume will be based on the length of the pack and the diameter of the hole drilled when the well was installed.

Purging will begin at those wells which have historically been low-yielding in order to allow sufficient time for recovery and sample collection.

4.3.5 *Sample Collection*

Wells will be purged and sampled at a sufficiently slow rate to prevent agitation inside the well. Sample water will be transferred to the sample containers in a way which will minimize agitation and aeration.

Samples will be obtained by lowering the disposable bailer into the well to ensure a representative sample for all analyzed constituents. The bailer will be lowered and raised gently through the water to reduce aeration.

Samples will be collected in the order of their volatilization sensitivity.

- Volatile Organic Compounds (VOCs)
- Semi Volatile Organic Compounds (SVOCs)
- Total Metals (unfiltered)

Samples collected for VOC analysis will be of sufficient volume so as to eliminate headspace in the sample container. After capping, the sample will be examined to ensure that no air bubbles are trapped in the VOC samples. Samples will be carefully poured from the bailer directly into the sample jars with minimal aeration. These procedures will minimize the possibility of loss of volatile constituents from the water sample.

4.3.6 *Field Equipment and Calibration*

In order to accurately collect and evaluate groundwater at the site, a variety of sampling and analytical equipment is required. All field measurement devices will be rinsed with deionized water prior to use for each sample. The water level indicator will be cleaned with laboratory detergent and triple rinsed with distilled water prior to field use; then rinsed with distilled water between each well. The following is a list of this equipment and the appropriate calibration methods. The calibration procedures, buffers and solutions, etc., used for each instrument will be recorded on the field data sheet for each well.

4.3.6.1 *Mercury Thermometer/Electrical Thermometer*

A thermometer will be utilized to accurately measure water temperature during sampling. The thermometer is factory calibrated when manufactured and requires no further calibration.

4.3.6.2 *pH Meter*

A pH meter will be employed to determine the degree of acidity or alkalinity of a sample. The pH meter is calibrated by immersing the electrode in standard buffer of known pH. The meter is then adjusted to account for temperature variations of the sample. Using a second standard buffer, the calibration is verified. Measurement accuracy is enhanced by selecting a standard buffer with a pH as close as possible to that of the sample (preferably within three pH units). The meter will be calibrated at the start of each field day. The meter will be checked against a standard buffer of known pH prior to each sample measurement. If the meter reads a measurement more than 0.2 standard units from the buffer, the meter will be recalibrated.

4.3.6.3 *Electrical Conductivity Meter*

An electrical conductivity meter will be used for measuring the specific conductance and obtaining an initial estimate of the total ionic content of the sample. The electrical conductivity meter is calibrated by immersing the probe in a standard solution of known conductivity. The temperature of the sample should also be known so that the meter can be properly adjusted to compensate for variations from sample to sample. The meter will be calibrated at the start of each field day. The meter will be checked against a standard solution of known conductivity prior to each sample measurement. If the meter reads a measurement more than 5% from the standard solution, the meter will be recalibrated.

4.3.6.4 *Turbidity Meter*

Turbidity will be measured in the field with a turbidity meter. Particles in turbid water will cause light to scatter giving it a "cloudy" appearance. The meter determines turbidity by measuring the amount of scatter when a light is passed through a sample. Readings are accomplished by placing a small amount of sample in a glass vial and placing the vial in the instrument. The vial will be rinsed with deionized water between readings. Care will be taken to keep the outside of the vial clean and free of fingerprints. The meter will be calibrated at least daily. Calibration is accomplished using at least two standards of known turbidity. If needed, the meter will be adjusted during the calibration until the value of the standard is properly displayed. The calibration will be checked several times daily in the field by reading the turbidity of the known standards. If the readings differ from the standard values by more than 10%, the meter will be recalibrated in the field. Calibration information for the turbidity meter will be recorded in a field logbook. Field turbidity readings for samples will be recorded on the field data sheet.

4.3.6.5 *Water Level Indicator*

The water level indicator is a probe and electrical tape assembly employed to detect water levels in bore holes, wells, and other open underground structures. Water levels are measured to within an accuracy of 0.01 foot by lowering the tape into the well. The alarm or indicator light activates when the probe encounters the water surface. The depth to the water is then read directly from the tape with respect to a surveyed elevation at the top of the well casing.

4.3.6.6 *Immiscible Layer Probe*

If the analytical data indicate that groundwater contamination may exist (i.e., detection of VOCs), an interface meter will be used for the detection and measurement of immiscible layers. The meter consists of a probe and electrical tape assembly which can be used to measure both floating and sinking layers. The meter uses an infrared beam and a receptor to detect non-aqueous liquids. A buzzer and two lights indicate non-aqueous liquids. To detect water, a conductivity circuit is used. The water completes the conductivity circuit and a single light is activated. The depth to the air/non-aqueous liquid interface is determined by reading the depth at which the buzzer and two lights are activated. The probe is lowered further to the depth of the non-aqueous liquid/water interface as evidenced by the single light. The thickness of the non-aqueous layer is then determined by subtraction. The presence/absence of dense sinking layers is determined by lowering the probe to the bottom of the well and by the same procedures described above.

4.3.6.7 *Other Equipment*

Other instruments that might become necessary during the field sampling will be calibrated according to the manufacturer's recommendations and/or generally accepted practice. Calibration procedures will be recorded.

Additional equipment, supplies, and material that will be necessary to facilitate the collection of groundwater samples at the site include, but are not limited to:

- Stainless steel, Teflon, and/or PVC bailer
- Polypropylene rope
- Plastic sheeting
- Disposable nitrile and/or latex gloves
- Sample coolers and wet ice
- 5-gallon bucket(s) (calibrated in 1-gallon increments)
- Container for measurement of field parameters
- Assorted miscellaneous tools

4.4 SAMPLE QA/QC HANDLING AND DOCUMENTATION

4.4.1 Sample Quality Assessment/ Quality Control

A quality assurance and quality control (QA/QC) program will be established to ensure the reliability and validity of field and analytical laboratory data gathered as part of the overall groundwater monitoring and testing program. This program will be divided into two segments: a field QA/QC program and a laboratory QA/QC program. The following sections outline the methods proposed for each of these programs.

4.4.1.1 *Field QA/QC*

For the sampling events, field duplicates will be collected from randomly selected well(s) at a rate of 10% of the monitoring samples. The field duplicates will be collected following the same procedures as those used to collect the other samples. Both sets of bottles for the duplicates will be filled in the sequence specified in Section 4.3.5. For example, both sets of bottles for VOCs will be filled first followed by both sets for total metals (unfiltered), etc. The field duplicate samples will be analyzed for the same parameters as the other samples. Field measured parameters will also be recorded for the duplicate. The well(s) selected for duplicate sampling will differ from event to event.

In general, field blanks will not be collected because only decontaminated disposable sampling equipment will be utilized. If Lubrizol elects to collect a field blank, the blank will be collected by filling a set of sample containers with Type II reagent-grade water.

Equipment blanks will also generally not be collected as disposable bailers will be utilized to purge and sample the monitoring wells. If any non-disposable/non-dedicated equipment is used for purging or sample collection, Lubrizol may collect an equipment blank. One method for collecting the field blank will involve filling the decontaminated device with Type II water and then pouring the Type II water from the device into the sample bottles. Alternatively, the equipment blank may be filled by rinsing the decontaminated device with Type II water and collecting the rinse water in the sample bottles. The field-bias blanks will be analyzed for the same water quality parameters as the other samples.

One trip blank per cooler will be included with the samples. The trip blanks will be filled directly with distilled water at the laboratory before going into the field and will be carried along with the other sample sets. The trip blank sample will be analyzed for VOCs only.

The results of the analyses of the blanks will not be used to correct the groundwater data. If contaminants are found in the blanks, an attempt will be made to determine the source of the contaminants.

Potential interferences to sample integrity may exist due to improper well construction, atmospheric conditions, improper sampling methods, geologic material, etc. The sampler(s) will conduct the sampling events in a manner which minimizes the potential for interference. In the event that the structural integrity of a monitor well is in question (as discussed above), the monitor well will be repaired or replaced as quickly as possible. In an attempt to eliminate potential airborne contaminants or dust from jeopardizing the integrity of a sample, the samples will be collected, if possible, during periods of decreased operations (such as tilling of farm fields) upwind of the monitor well. The procedures discussed in Section 4.3 of this plan will be followed to ensure that the integrity of each groundwater sample is not jeopardized by improper collection or handling (i.e., new clean gloves at each well location, zero headspace in volatile samples, etc.). As excessive turbidity may affect certain analyses (metals will adsorb to the soil particles), the monitor wells will be evaluated during each sampling event to determine whether redevelopment, as discussed in Section 4.2, will be necessary.

For total metals (unfiltered) analyses, samples are collected in containers preserved by the laboratory with nitric acid. The acid lowers the pH of the sample to less than 2 standard units. This pH level will cause some suspended particles to dissolve. Thus, the total metals content analyzed in the sample may be higher than the actual *in situ* conditions.

4.4.1.2 *Laboratory QA/QC Program*

The laboratory QA/QC will provide for the use of standards, laboratory blanks, duplicates, and spiked samples for calibration and identification of potential matrix interferences. The laboratory will use adequate statistical procedures (QC charts) to monitor and document performance and implement an effective program to resolve testing problems. Data from QC samples (blanks, spiked samples) will be used as a measure of performance or as an indicator of potential sources of cross-contamination, but will not be used to alter or correct analytical data. Matrix spikes, matrix spike duplicates, lab control samples, and method blanks for organics and total metals (unfiltered) will be analyzed at a minimum of one per sample batch (20 samples maximum per batch). Surrogate spikes for organics will be analyzed for each sample.

Potential interferences and the techniques to counteract them are as follows:

- Interferences purged or co-extracted from the samples will vary considerably from source to source, depending upon the particular sample or extract being tested. The analytical system, however, will be checked to ensure freedom from interferences, under the analysis conditions, by analyzing method blanks.

- Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal into the sample during shipment and storage. Trip blanks prepared from reagent water and carried through the sampling and handling protocol will serve as checks on such contamination.

- Cross-contamination can occur whenever high-level and low-level sample are analyzed sequentially. Whenever an unusually concentrated sample is analyzed, it will be followed by the analysis of reagent water to check for cross-contamination. The purge-and-trap system may require extensive bake-out and cleaning after a high-level sample.

Impurities in the purge gas and from organic compounds out gassing from the plumbing ahead of the trap account for the majority of contamination problems. The analytical system will be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks. The use of non-Teflon plastic coating, non-Teflon thread sealants, or flow controlled with rubber components in the purging device will be avoided.

4.4.2 *Sample Preservation and Shipment*

4.4.2.1 *Sample Containers and Presevatives*

The appropriate sample containers and associated preservatives will be prepared in the laboratory prior to shipment of the containers to the site. The sample containers will be carefully inventoried prior to initiation of the sampling event in order to rectify any problems that may occur.

4.4.2.2 *Sample Labels*

To prevent misidentification of samples, a label will be security fixed to each sample container. These labels will be waterproof and carry the following information:

- Project name and number

- Sample identification number
- Analytical parameters
- Initials of collector
- Date and time of collection
- Preservatives used

The labels will be affixed to the appropriate sample containers at the laboratory, prior to shipment to the site, and completed in the field.

4.4.2.3 *Sample Transport*

Following collection, samples will be transferred to an iced cooler. Wet ice packs will be used to maintain a constant temperature of 4°C within the cooler. To minimize the possibility of container breakage, void space within the cooler will be filled with suitable packaging material, such as bubble wrap. Samples will be transported to the analyzing laboratory via an overnight courier. Rapid return of the samples to the laboratory will ensure that the maximum holding times for the various parameters are not exceeded. The method of shipment and tracking number will be included on the chain-of-custody (discussed in Section 4.4.3 below). All current regulations (Department of Transportation, International Air Transport Association, courier-specific, etc.) will be observed during the packaging, labeling, and shipment of the samples.

4.4.3 Chain of Custody Procedures

The purpose of the chain-of-custody program is the tracking of possession and handling of individual samples from the time of field collection through laboratory analysis. This program will include sample labels, chain-of-custody records, and laboratory logbook.

4.4.3.1 *Sample Seals*

In the case where samples will leave the immediate control of the sample collector or custodian, such as shipment to the laboratory by the overnight courier, a seal will be provided on the shipping container to ensure that the samples have not been disturbed during transportation.

4.4.3.2 *Chain of Custody Records*

To establish the documentation necessary to trace sample possession, a chain-of-custody record will be filled out and accompany every sample. An example of a chain-of-custody tracking sheet is included in Appendix C of this plan. The record will contain the following information:

- Identification of well(s)
- Signature of collector
- Date and time of collection
- Sample type (matrix)
- Container types and volumes
- Preservation method
- Number of containers
- Parameters requested for analysis
- Signature of persons involved in the chain of possession Inclusive dates of possession
- Temperature of sample cooler upon receipt at laboratory.

4.4.3.3 *Laboratory Logbook*

When a sample is shipped to the laboratory, the sample custodian or laboratory personnel will clearly document the processing steps that are applied to the sample. All sample preparation techniques and instrumental methods will be identified in a laboratory logbook. Experimental conditions, such as the use of specific reagents, temperatures, reaction times, and instrument settings will be noted in the logbook. The results of the analysis of all quality control samples will be identified, specific to each batch of groundwater samples analyzed. The laboratory logbook will include the time, date, and name of the person who performed each processing step. Deviations in analytical or lab procedures will be noted in the logbook and in the report of the laboratory results.

4.5 *DECONTAMINATION PROCEDURES*

The following steps will be used to decontaminate non-dedicated sampling equipment used at the site:

Water Level Probe and Tape when Measuring Total Depth of Well:

- The entire length of water level probe and tape that comes into contact with water in the well will be wiped down with a clean disposable paper towel saturated with deionized/distilled water followed by rinsing with deionized/distilled water. If light or heavy phases are found in a well, a clean disposable paper towel soaked with methanol should be used to wipe all parts in contact with the water in the well, followed by repeated flushing with copious amounts of deionized/distilled water.

Other Non-Dedicated / Non Disposable Sampling Equipment:

- Wash equipment with non-phosphate detergent and potable water.
- Equipment will be rinsed liberally with potable water.
- If analysis for metals is being conducted, the equipment will be rinsed with a solution of 10% hydrochloric or nitric acid.
- Equipment will be rinsed liberally with deionized with deionized/distilled water (ASTM Type II or equivalent).
- If analysis for organics is being conducted, the equipment will be rinsed with solvent-pesticide grade isopropanol or methanol alone or if required, in some combination. The solvent rinse will not be an analyte of interest.
- Equipment will be rinsed liberally again with deionized/distilled water (ASTM Type II or equivalent).
- Equipment will be air-dried completely before use.
- Equipment will be wrapped with an inert material if not used promptly.

5.0 DATA REPORTING

5.1 ANALYTICAL PROCEDURES & LABORATORY REPORTING

The analytical procedures for each parameter will include suitable standard analytical methods as well as proper quality assurance and quality control protocols as per SW 846. Records of groundwater analyses will include the methods used, extraction date, and date of actual analysis. Data from samples that are not analyzed within recommended holding times will be considered suspect. Every attempt will be made to ensure that the samples do not age beyond their corresponding holding times.

Analytical data will be reported by the laboratory through the preparation of the following:

1. Analytical data submission (including method blanks, trip blanks, and field blanks, if collected).

2. The sample analytical report will contain sample concentrations and detection limits (as applicable) for each parameter.

The standard reporting limits will be below drinking water maximum contaminant levels (MCLs) for parameters with established MCLs.

5.2 METHOD OF INTERPRETING AND REPORTING DATA

The analytical data will be evaluated to ensure that analytical/reporting errors have not occurred, and text describing the results of that evaluation, including deviations from the approved methodology and QA/QC parameters, will be prepared.

The results of the sampling will be summarized to the USEPA, within 75 days of the sampling event, in a letter report containing tabulated data for the wells sampled. The report submittals shall consist of, at a minimum, the following:

a) Lab data sheets.

b) Field and laboratory quality assurance / quality control (QA/QC) data.

c) Chain of custody and sample receipt forms including preservation methods.

d) Data summary table(s).

e) Updated potentiometric maps.

6.0 *PERSONNEL TRAINING*

Prior to participation in a sampling event, all personnel will have successfully met the requirements of the HAZWOPER 40 Hour Health and Safety Program and undergone supervision and training to assure that all sampling protocols are followed. All personnel will have read and acknowledged the site specific Health and Safety Plan.

Personnel will be trained to perform all tasks associated with sample collection, including proper use of field equipment, data recording, chain-of-custody procedures, and decontamination. Each member of the sampling team will be completely familiar with this Sampling and Analysis Plan and a copy of the plan will accompany the sampling personnel during sampling events.

Appendix A
Boring/Monitoring Well Logs

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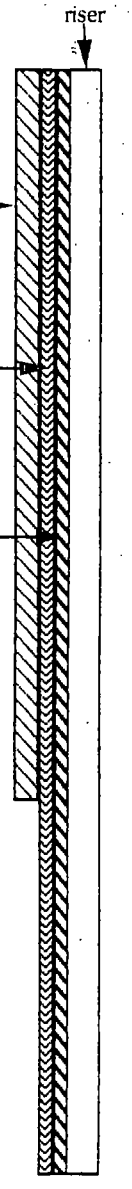
(614) 433-7900

Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-1/SB-2
Project: Perimeter Boring/Monitoring Well Phase		Well Construction Data	
Started: 7/9/96	Date Completed: 7/16/96	Screen: 2" PVC	From: 46 ft. To: 36 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 Quartz sand	From: 46 ft. To: 35 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 35 ft. To: 33 ft.
Method: HSA	Equipment: CME	Grout: cement/bentonite	From: 33 ft. To: 0 ft.
Boring Depth: 46 ft.	Ground Surface Elevation:	Inner Casing: PVC	
Initial GW Level:	GW Level: 19.66 ft. Time/Date 7/23/96	Outer Casing/Stick Up: 6" steel casing/14" steel casing	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
0	SS-1	0-2'	2-4-4-3	19	0-4' - Sandy silt, dark brown, stained black, damp, slight odor.	
	SS-2	2'-4'	4-4-4-4	43		
	SS-3	4'-6'	5-9-9-7	65	4'-9.5' - Silt, stained black, moist to wet, odor	14" steel casing 0-20'
5					Water @ 5'	
	SS-4	6'-8'	6-8-8-10	129		
	SS-5	8'-10'	1-4-4-4	159		6" steel casing 0'-35'
10	SS-6	10'-12'	1-4-3-7	1	9.5'-25' - Silty clay, gray ,moist, no odor	cement/bentonite grout 0-33'
15	SS-7	15'-17'	3-3-4-6	133		
20	SS-8	20'-22'	4-4-6-8	0		
25	SS-9	25'-27'	4-6-8-10	10	25'-32' - Clay , grey w/ pinkish striations, damp, no odor	
30	SS-10	30'-32'	6-10-13-15	0		

Well Construction



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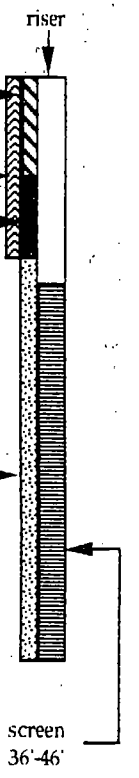
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-1/SB-2
Project: Perimeter Boring/Monitoring Well Phase		Well Construction Data	
Started: 7/9/96	Date Completed: 7/16/96	Screen: 2" PVC	From: 46 ft. To: 36 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 46 ft. To: 35 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 35 ft. To: 33 ft.
Method: HSA	Equipment: CME	Grout: bentonite/cement	From: 33 ft. To: 0 ft.
Boring Depth: 46 ft.	Ground Surface Elevation:	Inner Casing: PVC	
Initial GW Level:	GW Level: 19.66 ft. Time/Date 7/23/96	Outer Casing/Stick Up: 6" steel casing/14" steel casing	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
30	SS-11	32'-34'	50/1		Spoon refusal @ 32'	Cement/Bentonite grout 0'-33'
					Bedrock @ 32'	6" outer casing +3'-35'
35						Bentonite seal 33'-35'
40						#5 Quarts sand 35'-46'
45						
50						
55						
60						



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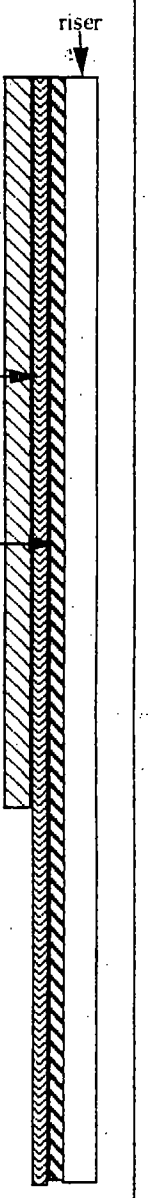
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-2/SB-5
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 6/26/96	Date Completed: 7/16/96	Screen: 2" PVC	From: 56 ft. To: 46 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 Quartz sand	From: 56 ft. To: 44 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 44ft. To: 41ft.
Method: HSA	Equipment: CME	Grout: cement/bentonite	From: 41ft. To: 0 ft.
Boring Depth: 56 ft.	Ground Surface Elevation:	Inner Casing: PVC	
Initial GW Level:	GW Level: 21.14 ft. Time/Date 7/23/96	Outer Casing/Stick Up: 6" steel casing / 14" steel casing	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
0	SS-1	0-2'	2-2-7-9	1	0-2' - Silty caly w/ trace gravel, brown, damp, no odor.	
	SS-2	2'-4'	3-5-7-7	2	2'-5' - Sandy silt w/ trace gravel, orange-brown, damp, no odor	14" steel casing 0-20'
	SS-3	4'-6'	3-11-15-17	30		
5	SS-4	6'-8'	6-6-2-8	70	5'-8' - Silt, stained black, moist, slight odor Water @ 8'	
	SS-5	8'-10'	6-8-12-12	120	8'-10' - Silty clay, stained black, wet, slight odor	6" steel casing 0'-39'
10	SS-6	10'-12'	2-4-4-10	200	... sand layer @ 10' 11'-39' - Silty clay, grey , moist towet, no odor	cement/bentonite grout 0-41'
15	SS-7	15'-17'	2-2-4-8	15		
20	SS-8	20'-22'	2-2-4-10	5		
25	SS-9	25'-27'	4-6-8-10	0.3		
30	SS-10	30'-32'	6-10-13-15	0.5		

Well Construction



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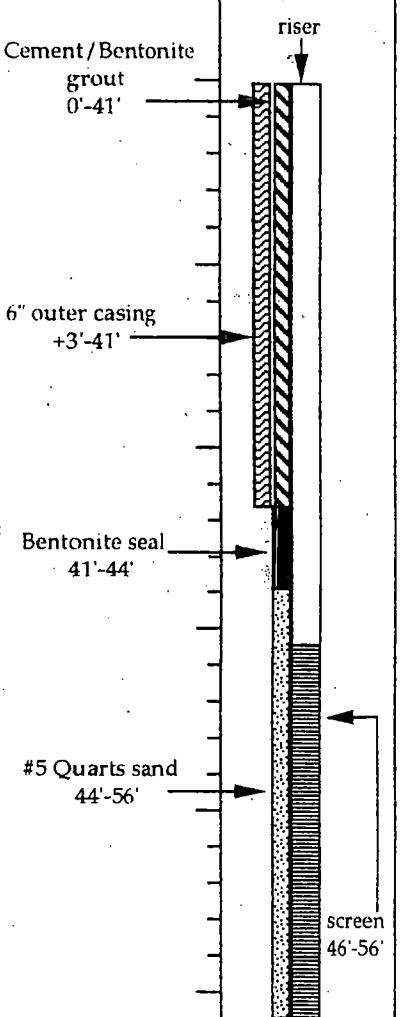
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-2/SB-5
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 7/9/96	Date Completed: 7/16/96	Screen: 2" PVC	From: 56 ft. To: 46 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 56 ft. To: 44 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 44 ft. To: 41ft.
Method: HSA	Equipment: CME	Grout: bentonite / cement	From: 41 ft. To: 0 ft.
Boring Depth: 56 ft.	Ground Surface Elevation:	Inner Casing: PVC	
Initial GW Level:	GW Level: 21.14ft. Time/Date 7/23/96	Outer Casing/Stick Up: 6" steel casing / 14" steel casing	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
30						
	SS-11	32'-34'	3-5-12-10	0.5	Silty clay, grey, moist, no odor	
35						
	SS-12	39'-41'	50/0		Spoon refusal @ 39'	
40					Bedrock @ 39'	
45						
50						
55						
60						



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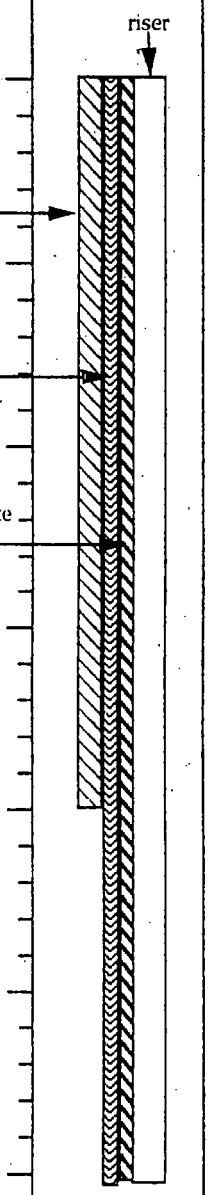
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	**Boring/Well I.D.:** MW-3/SB-9
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 7/9/96	Date Completed: 7/15/96	Screen: 2" PVC	From: 46 ft. To: 36 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 Quartz sand	From: 46 ft. To: 34 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 34ft. To: 31ft.
Method: HSA	Equipment: CME	Grout: cement/bentonite	From: 31ft. To: 0 ft.
Boring Depth: 46 ft.	Ground Surface Elevation:	Inner Casing: PVC	
Initial GW Level:	GW Level: 20.47 ft. Time/Date 7/23/96	Outer Casing/Stick Up: 6" steel casing / 14" steel casing	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description
0	SS-1	0-2'	2-3-4-3	4.7	0-2' - TOPSOIL - Sand y, brown, dry, no odor.
	SS-2	2'-4'	1-2-2-2	11.6	2'-4' - Silty sand w/ trace gravel and organics, brown, dry, no odor
	SS-3	4'-6'	1-3-3-4	8	4'-6.5' - Sand, brown, wet, no odor
5					... stained black @ 5'
	SS-4	6'-8'	6-8-10-10	61	Water @ 5'
					6.5'-15' - Silt, stained black, wet, slight odor
	SS-5	8'-10'	6-9-8-4	74	... sand layer @ 8'
10	SS-6	10'-12'	2-3-3-5	112	
15	SS-7	15'-17'	1-3-5-7	1.8	15'-25' - Silty clay, grey , moist to damp, no odor
20	SS-8	20'-22'	2-7-9-8	0.3	
25	SS-9	25'-27'	5-8-10-10	0	25'-34' - Clay w/ trace silt, gray,damp, no odor
30	SS-10	30'-32'	5-15-17-16	0	

Remarks: 14" steel casing 0-20'; 6" steel casing 0'-37'; cement/bentonite grout 0-31'

Well Construction: riser



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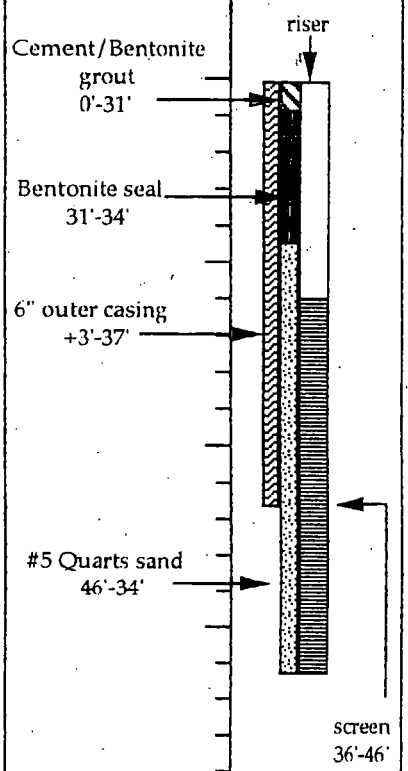
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-3/SB-9
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 7/9/96	Date Completed: 7/15/96	Screen: 2" PVC	From: 46 ft. To: 36 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 46 ft. To: 34 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 354ft To: 31 ft.
Method: HSA	Equipment: CME	Grout: bentonite / cement	From: 31 ft. To: 0 ft.
Boring Depth: 46 ft.	Ground Surface Elevation:	Inner Casing: PVC	
Initial GW Level:	GW Level: 20.47 ft. Time/Date 7/23/96	Outer Casing/Stick Up: 6" steel casing / 14" steel casing	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
30						
	SS-11	34'-36'	5-8-8-10	0.5	Bedrock @ 33' 34'-36' - Weathered limestone, pebble to cobble size, some silt and clay, moist, no odor	
35						
40						
45						
50						
55						
60						

Well Construction



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Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-4
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 6/25/96	Date Completed: 6/25/96	Screen: 2" PVC	From: 4 To: 14 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 2 To: 14 ft.
Drilling Co.: PHILIP ENV.	Driller: RANDY BURNS	Seal: bentonite	From: 0 To: 2ft.
Method: HSA	Equipment: CME	Grout: N/A	From: To:
Boring Depth: 14ft.	Ground Surface Elevation:	Inner Casing: 2" PVC	
Initial GW Level: approx. 5 ft.	GW Level: 4.45 ft. Time/Date 7/23/96	Outer Casing/Stick Up: N/A	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks	Well Construction
0					Lithological and analytical samples taken during the drilling of SB-7	Bentonite 0-2'	riser 0-4'
5						#5 Quartz sand 2'-14'	screen 4'-14'
10							
15							
20							
25							
30							

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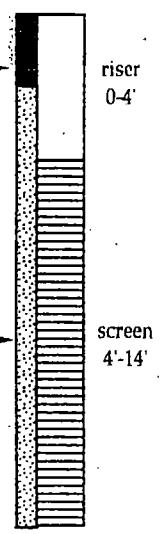
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-5/SB-11
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 6/27/96	Date Completed: 6/27/96	Screen: 2" PVC	From: 4 To: 14 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 2 To: 14 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 0 To: 2ft.
Method: HSA	Equipment: CME	Grout: N/A	From: To:
Boring Depth: 14ft.	Ground Surface Elevation:	Inner Casing: 2" PVC	
Initial GW Level: approx. 5 ft.	GW Level: 4.69 ft. Time/Date 7/22/96	Outer Casing/Stick Up: N/A	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
0	SS-1	0-2'	3-3-3-4	> 1000	0-4' - Sandy silt w/ trace gravel, reddish-brown, damp, strong odor.	Bentonite 0-2'
	SS-2	2'-4'	2-6-6-8	900		
	SS-3	4'-6'	4-4-4-4	700	4'-6' - Silt, stained black, moist, strong odor	
5	SS-4	6'-8'	4-4-8-17	980	6'-8.5' - Clayey silt, stained black, sat., strong odor	
	SS-5	8'-10'	4-8-8-6	350	Water @ 7' 8.5'-14' Silty clay, gray, little to no staining, wet , slight to no odor	#5 Quartz sand 2'-14'
10	SS-6	10'-12'	2-2-4-8	280	Silt layer 10' to 10.5'	
	SS-7	12'-14'	2-6-8-6	80		
15						
20						
25						
30						



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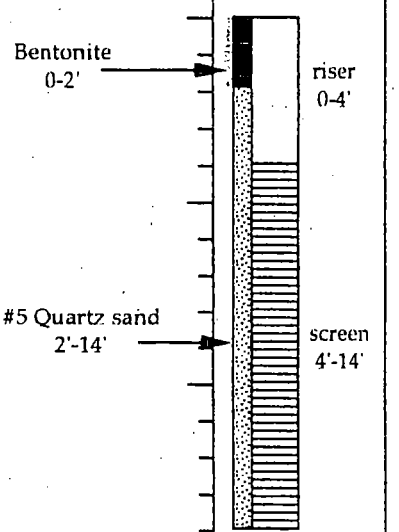
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-6/SB-4
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 6/27/96	Date Completed: 6/27/96	Screen: 2" PVC	From: 4 To: 14 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 2 To: 14 ft.
Drilling Co.: PHILIP ENV.	Driller: KENT MOORE	Seal: bentonite	From: 0 To: 2ft.
Method: HSA	Equipment: CME	Grout: N/A	From: To:
Boring Depth: 14ft.	Ground Surface Elevation:	Inner Casing: 2" PVC	
Initial GW Level: approx. 2 ft.	GW Level: 3.42 ft. Time/Date 7/22/96	Outer Casing/Stick Up: N/A	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
0	SS-1	0-2'	2-2-4-5	120	0-4' - Sandy silt, brownish -red, damp, slight odor.	
	SS-2	2'-4'	2-2-6-8	110	....stained black from 2'-3'	
	SS-3	4'-6'	2-4-8-10	180	4'-10' - Silt, stained black, moist, slight to no odor	
5	SS-4	6'-8'	8-12-14-20	120		
	SS-5	8'-10'	2-12-14-18	980	.....saturated at 8' Water @ 8.5'	
	SS-6	10'-12'	4-6-6-10	410	8'-14' Silty clay, gray, stained black, wet , slight to no odor.	
	SS-7	12'-14'	2-6-8-10	380		
10						
15						
20						
25						
30						



Well Construction

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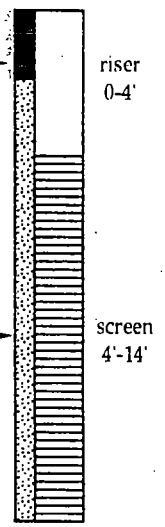
Boring /Monitoring Well Log

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-7/SB-1
Project: Perimeter Boring / Monitoring Well Phase		Well Construction Data	
Started: 7/1/96	Date Completed: 7/1/96	Screen: 2" PVC	From: 4 To: 14 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 2 To: 14 ft.
Drilling Co.: PHILIP ENV.	Driller: RANDY BURNS	Seal: bentonite	From: 0 To: 2ft.
Method: HSA	Equipment: CME	Grout: N/A	From: To:
Boring Depth: 14ft.	Ground Surface Elevation:	Inner Casing: 2" PVC	
Initial GW Level: approx. 5 ft.	GW Level: 4.45 ft. Time/Date 7/22/96	Outer Casing/Stick Up: N/A	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
0	SS-1	0-2'	4-16-8-10	0	0-5.5' - Sandy silt w/ gravel, reddish-gray, moist, no odor.	Bentonite 0-2'
	SS-2	2'-4'	2-3-4-3	0		
	SS-3	4'-6'	2-3-8-8	16		
5	SS-4	6'-8'	5-6-6-9	32	5.5'-8' - Silt, stained black, moist, slight to no odor Water @ 6'	
	SS-5	8'-10'	8-9-12-14	104	8'-11.5' - Silt, gray, wet to saturated, no odor	#5 Quartz sand 2'-14'
10	SS-6	10'-12'	3-5-5-6	140		
	SS-7	12'-14'	7-4-6-8	146	11.5'-14' Silty clay, gray, wet , no odor.	
15						
20						
25						
30						

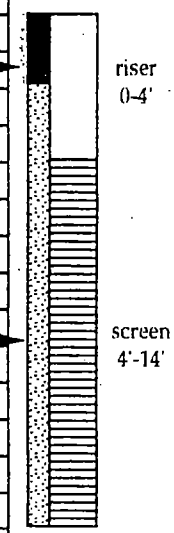


Boring /Monitoring Well Log

ERM
355 EAST CAMPUS VIEW
SUITE 250
COLUMBUS, OHIO
(614) 433-7900

Client: Lubrizol Corporation		WO#: 09928.00.01	Boring/Well I.D.: MW-8/SB-6
Project: Perimeter Boring/ Monitoring Well Phase		Well Construction Data	
Started: 7/1/96	Date Completed: 7/1/96	Screen: 2" PVC	From: 4 To: 14 ft.
Logged By: M. BARNETT	Checked By: D. DENIRO	Pack: #5 quartz sand	From: 2 To: 14 ft.
Drilling Co.: PHILIP ENV.	Driller: RANDY BURNS	Seal: bentonite	From: 0 To: 2ft.
Method: HSA	Equipment: CME	Grout: N/A	From: To:
Boring Depth: 14ft.	Ground Surface Elevation:	Inner Casing: 2" PVC	
Initial GW Level: approx. 3 ft.	GW Level: 3.31 ft. Time/Date 7/22/96	Outer Casing/Stick Up: N/A	

Depth	Sample Type	Sample ID	Blow Counts	Headspace (ppm)	Description	Remarks
0	SS-1	0-2'	3-3-3-5	0	0-2' - Silty clay w/ sand & gravel, reddish-brown, dry, no odor.	Bentonite 0-2'
	SS-2	2'-4'	1-4-4-5	0	2'-5' - Sand w/ some silt & gravel, reddish-brown, moist, no odor	
	SS-3	4'-6'	4-7-13-9	0	Water @ 5'	
5					5'-8.5' - Silt, stained black, wet to saturated, no odor	
	SS-4	6'-8'	3-7-19-14	0	.....gray @ 7'	
	SS-5	8'-10'	2-5-6-10	0		#5 Quartz sand 2'-14'
					8.5'-14' Silty clay, gray, moist to wet , no odor.	
10	SS-6	10'-12'	3-4-4-10	0		
	SS-7	12'-14'	2-6-6-8	0		
15						
20						
25						
30						



Environmental Resources Management, Inc.

MW-9

WO No:	09928.00.01	Date Completed	2 Nov 98		
Project	Greiner's Lagoon	Owner	Lubrizol		
Location	Fremont, Ohio	Boring Depth (feet)	14'	Diameter	8.25"
Northing	N/A	Surface Elevation		feet msl	
Easting	N/A	Riser Elevation		feet msl	
Screen	Slotted PVC	Length (feet)	10'	Diameter	2"
Slot Size	0.01"	Stabilized DTW	N/A	feet TOC	N/A
Riser	PVC	Length (feet)	14'	Diameter	2"
Drilling Method	Hollow-Stem	Driller	Jeff	Geologist	Susan Dragt
Drilling Company	Sprowl's Drilling				

Location Sketch Map

Depth (feet BGS)	Graphic Log	Well Construction Schematic	PID Reading (PPM)	Blows per 0.5 feet	Split-Spoon #	Sample Depth (feet BGS)	Recovery	Sample Description/Classification
								Feet Below Ground Surface
0				2-4-4-5		0-2'		0-2' Sandy SILT, trace gravel, orange/brown, loose, moist to dry, no odor.
				3-2-5-5		2-4'		2-4' Same as above, but at approximately 4 feet, sand zone approximately 6 inches thick, moist.
				4-7-10-12		4-6'		4-6' As above, but at approximately 5 feet silty CLAY, gray/black, moist.
5								
				8-10-16-16		6-8'		6-8' SILT, gray/black, moist.
				4-6-6-12		8-10'		8-10' Silty CLAY, gray/black, moist to wet.
10				3-4-5-6		10-12'		10-12' As above.
				4-6-6-10		12-14'		12-14' As above.
15								End of boring at 14' Below Ground Surface (BGS)
20								

Environmental Resources Management, Inc.

MW-10

WO No:	09928.00.01	Date Completed	3 Nov 98				
Project	Greiner's Lagoon	Owner	Lubrizol				
Location	Fremont, Ohio	Boring Depth (feet)	14'	Diameter	8.25"		
Northing	N/A	Surface Elevation		feet msl			
Easting	N/A	Riser Elevation		feet msl			
Screen	Slotted PVC	Length (feet)	10'	Diameter	2"		
Slot Size	0.01"	Stabilized DTW	N/A	feet TOC	N/A		
Riser	PVC	Length (feet)	14'	Diameter	2"		
Drilling Method	Hollow-Stem	Driller	Jeff	Geologist	Susan Dragt	Location Sketch Map	
Drillng Company	Sprowl's Drilling						

Depth (feet BGS)	Graphic Log	Well Construction Schematic	PID Reading (PPM)	Blows per 0.5 feet	Split-Spoon #	Sample Depth (feet BGS)	Recovery	Sample Description/Classification
								Feet Below Ground Surface
0				3-3-6-8		0-2'		0-2' Sandy SILT, trace gravel, orange/brown, dry.
			3.8	3-5-4-3		2-4'		2-4'
				4-7-6-8		4-6'		4-6' Silty SAND grading to silty clay at approximately
5								5 feet, moist.
			3.6	4-8-11-15		6-8'		6-8' Silty CLAY, gray, moist.
			3.9	10-7-7-10		8-10'		8-10' CLAY, gray, moist.
10			3.5	3-4-6-7		10-12'		10-12' As above.
			3.5	2-4-6-8		12-14'		12-14' As above.
15								
20								

Environmental Resources Management, Inc.

MW-11

WO No:	09928.00.01	Date Completed			
Project	Greiner's Lagoon	Owner	Lubrizol		
Location	Fremont, Ohio	Boring Depth (feet)	14'	Diameter	8.25"
Northing	N/A	Surface Elevation		feet msl	
Easting	N/A	Riser Elevation		feet msl	
Screen	Slotted PVC	Length (feet)	10'	Diameter	2"
Slot Size	0.01"	Stabilized DTW	N/A	feet TOC	N/A
Riser	PVC	Length (feet)	14'	Diameter	2"
Drilling Method	Hollow-Stem	Driller	Jeff	Geologist	Bob Elliott
Drillng Company	Sprowl's Drilling				

Location Sketch Map

Depth (feet BGS)	Graphic Log	Well Construction Schematic	PID Reading (PPM)	Blows per 0.5 feet	Split-Spoon #	Sample Depth (feet BGS)	Recovery	Sample Description/Classification	
								Feet Below Ground Surface	
0			<0.1	2-4-6-6		0-2'	50	0-2'	SILT, little gravel, brown, dry, slightly stiff
									grades to light brown.
			<0.1	3-4-4-4		2-4'	70	2-4'	SILT, some sand, brown/grey, mottled, damp,
									friable.
			<0.1	3-4-5-6		4-6'	15	4-6'	SILT, grey/brown, mottled, damp, slightly friable,
5									3-1mm wide fine sand seams at approximately 5.5-
									6', 2" apart from each other.
			<0.1	8-5-5-9		6-8'	60	6-8'	Grey/brown, mottled, damp, grades to moist, at
									approximately 9.7' fine SAND, not dense, some silt.
			<0.1	3-3-4-5		8-10'	60	8-10'	Fine & Med. SAND, grey, moist, some silt, 2 dark
10									colored seams at 9.2' and 9.7'.
			<0.1	2-2-4-2		10-12'	80	10-12'	CLAY, dark grey, slightly moist, soft, slightly
									plastic, some silt.
			<0.1	2-4-2-2		12-14'	5	12-14'	CLAY, grey, moist, slightly plastic, little silt.
15									End of boring at 14' Below Ground Surface (BGS)
20									

Environmental Resources Management, Inc.

MW-12

WO No:	09928.00.01	Date Completed	2 Nov 98		
Project	Greiner's Lagoon	Owner	Lubrizol		
Location	Fremont, Ohio	Boring Depth (feet)	14'	Diameter	8.25"
Northing	N/A	Surface Elevation		feet msl	
Easting	N/A	Riser Elevation		feet msl	
Screen	Slotted PVC	Length (feet)	10'	Diameter	2"
Slot Size	0.01"	Stabilized DTW	N/A	feet TOC	N/A
Riser	PVC	Length (feet)	14'	Diameter	2"
Drilling Method	Hollow-Stem	Driller	Jeff	Geologist	Bob Elliott
Drillng Company	Sprowl's Drilling				

Location Sketch Map

Depth (feet BGS)	Graphic Log	Well Construction Schematic	PID Reading (PPM)	Blows per 0.5 feet	Split-Spoon #	Sample Depth (feet BGS)	Recovery	Sample Description/Classification	
								Feet Below Ground Surface	
0			<0.1	3-1-11-11		0-2'	70	0-2'	SILT, brown, dry, friable, some fine sand.
			<0.1	2-7-10-8		2-4'	80	2-4'	Fine SAND, borwn, dry, slightly dense, some
									gravel, little silt.
			<0.1	3-5-8-12		4-6'	70	4-6'	Med. & Fine SAND, brown, damp, loose, some silt.
5									
			<0.1	6-8-10-15		6-8'	70	6-7.5'	SILT, brown, damp, not dense, some fine sand.
								7.5-8'	SILT, dark grey to black, slightly moist, not dense,
									some fine sand.
			<0.1	6-5-5-2		8-10'	80	8-10'	CLAY & SILT, dark grey, damp, soft, plastic.
10			<0.1	3-4-7-8		10-12'	80	10-12'	CLAY, grey, damp, soft, plastic, some silt, at
									approx. 10.5'- 2mm wide wet med. sand layer.
			<0.1	2-3-5-7		12-14'	60	12-14'	CLAY, grey, damp, soft, plastic, some silt.
15									End of boring at 14' Below Ground Surface (BGS)
20									

Environmental Resources Management, Inc.

MW-13

WO No:	09928.00.01	Date Completed	3 Nov 98		
Project	Greiner's Lagoon	Owner	Lubrizol		
Location	Fremont, Ohio	Boring Depth (feet)	14'	Diameter	8.25"
Northing	N/A	Surface Elevation		feet msl	
Easting	N/A	Riser Elevation		feet msl	
Screen	Slotted PVC	Length (feet)	10'	Diameter	2"
Slot Size	0.01"	Stabilized DTW	N/A	feet TOC	N/A
Riser	PVC	Length (feet)	14'	Diameter	2"
Drilling Method	Hollow-Stem	Driller	Jeff	Geologist	Susan Dragt
Drillng Company	Sprowl's Drilling				

Location Sketch Map

Depth (feet BGS)	Graphic Log	Well Construction Schematic	PID Reading (PPM)	Blows per 0.5 feet	Split-Spoon #	Sample Depth (feet BGS)	Recovery	Sample Description/Classification	
								Feet Below Ground Surface	
0				1-3-3-5		0-2'		0-2'	Sandy SILT, orange/brown, dry.
				3-5-9-9		2-4'		2-4'	SAND, fine to med. grained, some silt, brown,
									moist to dry, no odors.
				3-7-11-13		4-6'		4-6'	As above, but becoming wet.
5									
				3-9-9-9		6-8'		6-8'	As above, but turning gray/black, organic odor.
			20.0	3-6-6-8		8-10'		8-10'	Sandy SILT with CLAY, gray/black, moist to wet.
10			9.0	4-4-10-13		10-12'		10-12'	CLAY, gray, moist.
			7.0	2-4-4-7		12-14'		12-14'	As above.
15									End of boring at 14' Below Ground Surface (BGS)
20									

Environmental Resources Management, Inc.

MW-14

WO No:	09928.00.01	Date Completed	2 Nov 98		
Project	Greiner's Lagoon	Owner	Lubrizol		
Location	Fremont, Ohio	Boring Depth (feet)	14'	Diameter	8.25"
Northing	N/A	Surface Elevation		feet msl	
Easting	N/A	Riser Elevation		feet msl	
Screen	Slotted PVC	Length (feet)	10'	Diameter	2"
Slot Size	0.01"	Stabilized DTW	N/A	feet TOC	N/A
Riser	PVC	Length (feet)	14'	Diameter	2"
Drilling Method	Hollow-Stem	Driller	Jeff	Geologist	Susan Dragt
Drilling Company	Sprowl's Drilling				

Location Sketch Map

Depth (feet BGS)	Graphic Log	Well Construction Schematic	PID Reading (PPM)	Blows per 0.5 feet	Split-Spoon #	Sample Depth (feet BGS)	Recovery	Sample Description/Classification	
								Feet Below Ground Surface	
0				1-2-3-4		0-2'		0-2'	Silty SAND, trace gravel, orange/brown, moist
									to dry.
				3-2-2-5		2-4'		2-4'	As above.
				3-6-9-2		4-6'		4-5'	Fine to Med. SAND, moist to wet, gray/brown.
5								5-6'	SILT, gray/brown, moist.
				9-18-26-25		6-8'		6-8'	SILT, as above, moist to wet.
				4-6-6-7		8-10'		8-10'	Silty CLAY, dark gray, moist to wet.
10				2-4-6-7		10-12'		10-12'	As above.
				2-3-4-8		12-14'		12-14'	CLAY, gray, moist.
15									End of boring at 14' Below Ground Surface (BGS)
20									

Appendix B
Groundwater Sampling Field Data Form

GROUNDWATER SAMPLING FIELD DATA FORM

Well Identification:

ERM
30775 Bainbridge Rd
Suite 180
Solon, OH 44139

Project: _____ Sample Date: _____

Project Number: _____ Sample Time: _____

Screened Interval: _____ Initial Depth to Water (ft): _____

Measured Well Depth (ft): _____ Length of Water Column (ft): _____

Well Inner Diameter (in): _____ 1 Well Volume (gal): _____

Water Volume/ft. for:
2" diameter well = 0.163 x LWC
4" diameter well = 0.653 x LWC
6" diameter well = 1.469 x LWC

Samplers: _____ Sampler Affiliation: _____

Purge Method/Equipment: _____

Stabilization Test Equipment: _____

Sampling Method/Equipment: _____

Stabilization Test:

Date	Time	Cummulative Volume (gal)	Depth to Water (ft)	pH	Specific Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (C)	ORP (mV)

Volume Purged Prior to Sample Collection: _____ Depth to Water during Sample Collection: _____

Analysis/Parameter	Container/Volume	Preservative/Preparation

Remarks:

Appendix C
Example Chain of Custody Record

CHAIN OF CUSTODY RECORD

To assist us in using the proper analytical methods, is this work being conducted for regulatory purposes?
Regulations to Appy [circle]: RCRA VAP UST Drinking H20 Wastewater None

Client Name: _____ client # _____ Compliance Monitoring? Yes No

Address: _____ **Project Name:** _____

City/State/Zip: _____ **Project #:** _____

Project Manager _____ email: _____ **Site/Location:** _____ STATE

Telephone Number: _____ **Fax No.:** _____ **Report to:** _____

Sampler Name: (Print) _____ **Invoice to:** _____

Sampler Signature: _____ **Quote #:** _____ **PO #**

Sample ID	Date Sampled	Time Sampled	G = Grab C = Composite	Field Filtered	SL - Sludge DW - Drinking H20 GW - groundwater S - Soil Solid WW - wastewater Other (specify)	Preservative: HNO_3 (Red Label)	HCl (Blue Label)	NaOH (Orange Label)	H_2SO_4 Plastic (Yellow Label)	Methanol	None (Black Label)	Other (Specify)	Analyze For:															RUSH TAT (Pre-Schedule)	RUSH Due Date	Standard TAT 8-10 Business Day	Fax Results	email results	Standard Level 2 QC	Electronic Deliverables	REMARKS

Special Instructions:

Laboratory Comments:

Initial Lab Temperature:

Received Lab Temperature:

Custody Seals: Y N

Bottles Supplied by TestAmerica Y N

Sample Containers Intact? Y N

Method of Shipment:

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by TestAmerica:	Date	Time

Tables

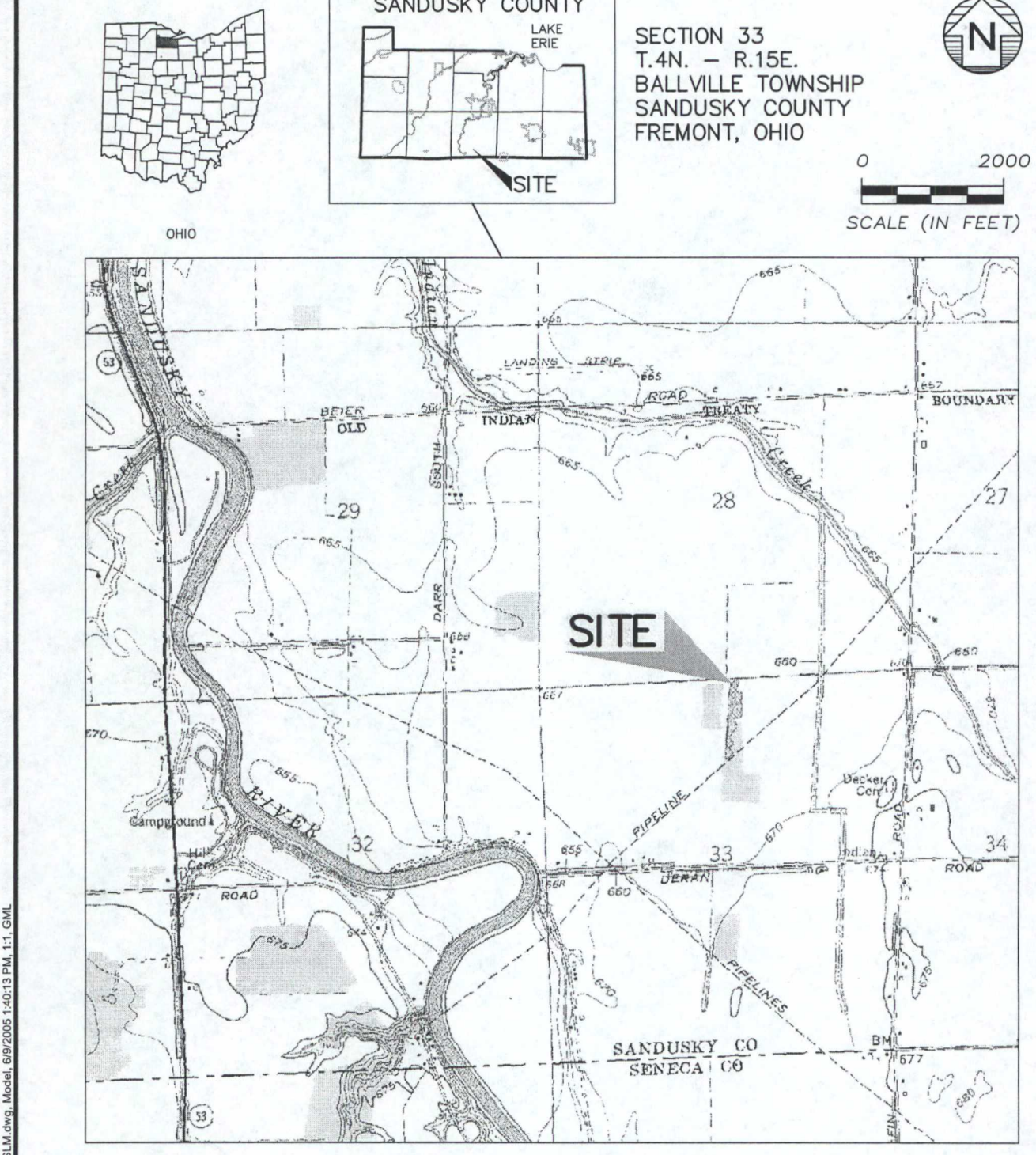
Table 1

SUMMARY OF MONITORING WELL CONSTRUCTION
GREINER'S LAGOON
FREMONT, OHIO

Well #	Date Installed	TOC	Depth (feet bgs)		Unit Monitored
			Top of Screen	Bottom of Screen	
MW-1	7/16/96	688.13	36	46	Bedrock Zone
MW-2	7/16/96	669.88	46	56	Bedrock Zone
MW-3	7/15/96	669.22	36	46	Bedrock Zone
MW-4	6/25/96	667.51	4	14	Shallow Zone
MW-5	6/27/96	668.56	4	14	Shallow Zone
MW-6	6/27/96	667.45	4	14	Shallow Zone
MW-7	7/1/96	668.09	4	14	Shallow Zone
MW-8	7/1/96	667.17	4	14	Shallow Zone
MW-9	11/2/98	669.13	4	14	Shallow Zone
MW-10	11/3/98	670.82	4	14	Shallow Zone
MW-11	11/3/98	669.45	4	14	Shallow Zone
MW-12	11/2/98	669.89	4	14	Shallow Zone
MW-13	11/3/98	669.80	4	14	Shallow Zone
MW-14	11/2/98	669.70	4	14	Shallow Zone

Notes:
toc = top of casing
bgs = below ground surface

Figures



SITE LOCATION MAP

ADAPTED FROM USGS
FREMONT WEST/1980

REVISIONS ARE TO BE MADE ON THE CADD FILE ONLY

ERM.	**LUBRIZOL** GREINER'S LAGOON SITE FREMONT, OHIO	CADD Review CHK'D 0004100
Drawn By FAK 5/20/05	Environmental Resources Management	FIGURE 1

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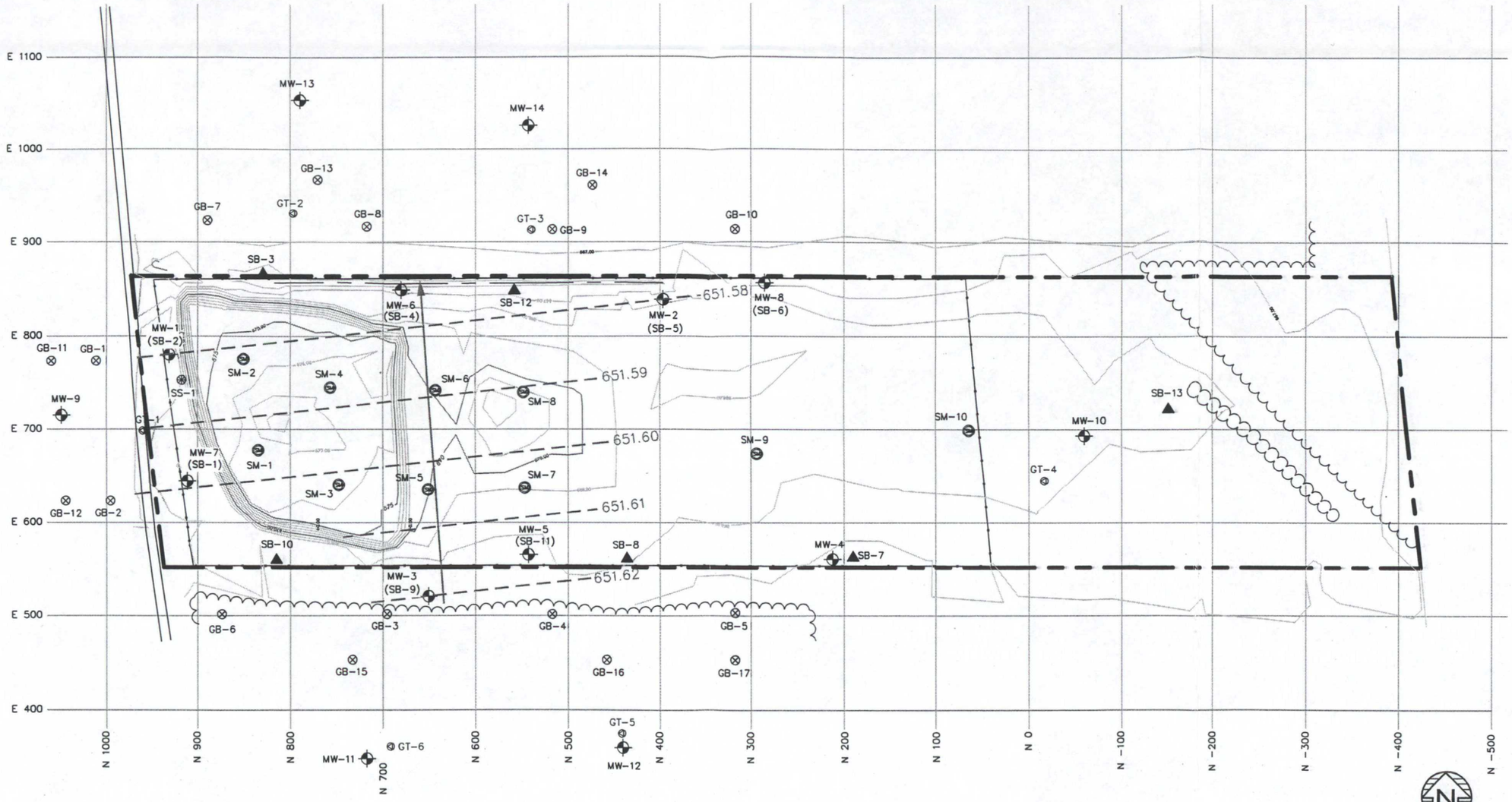
APRIL 1999 POTENTIOMETRIC CONTOUR MAP – BEDROCK AQUIFER



LEGEND

- MW-7 — GB-1
- SM-2 — SS-1
- SB-10 — SW/SED-1
- BG-1 — GT-6
- GROUND WATER ELEVATION CONTOUR (FT.)
- GROUND WATER FLOW DIRECTION

Drawn By GML	LUBRIZOL GREINER'S LAGOON SITE FREMONT, OHIO	CHK'D
CADD Review		0004100
Date Drawn/Rev'd 6/1/05	Environmental Resources Management	FIGURE 2

ERM

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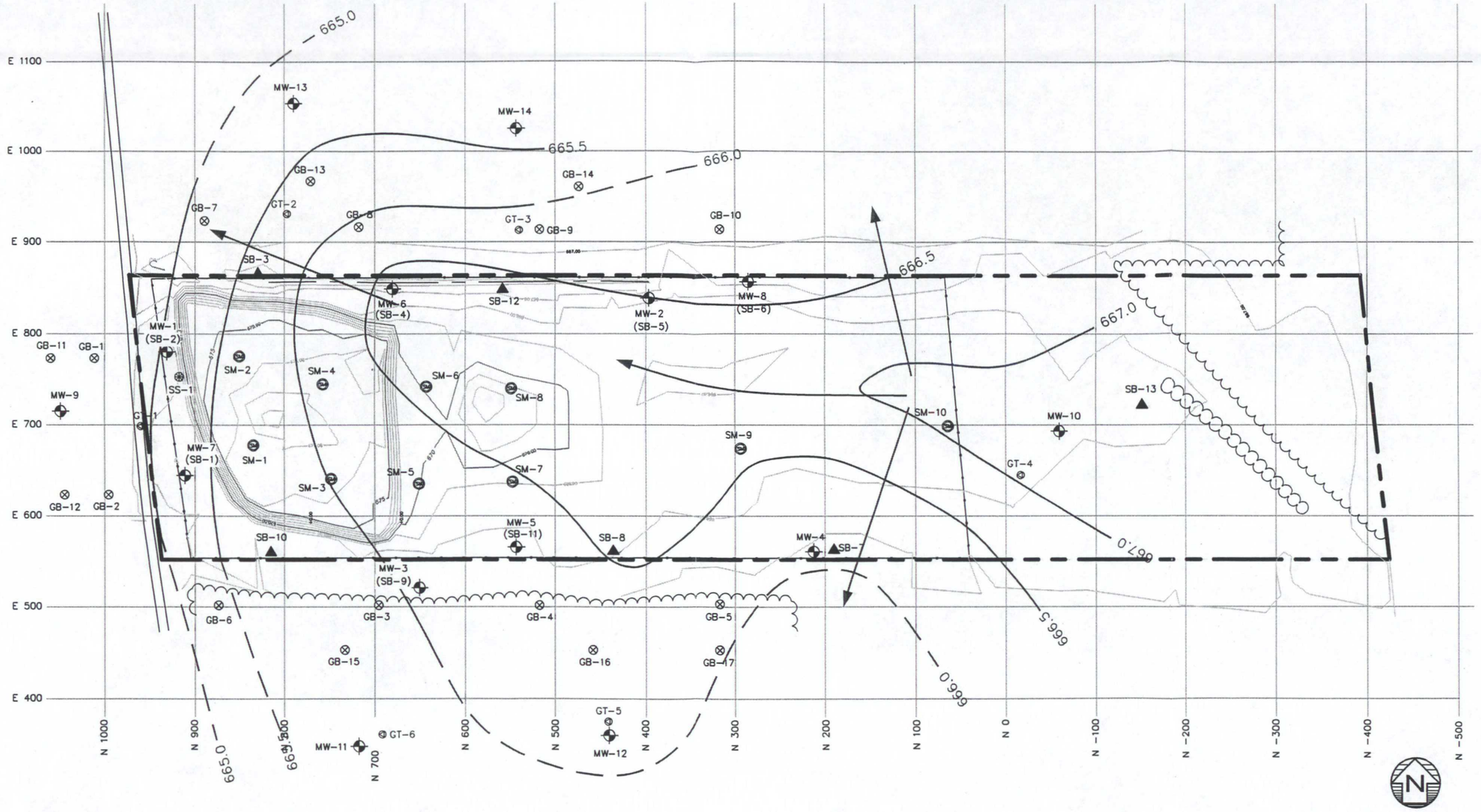
APRIL 1999 POTENTIOMETRIC CONTOUR MAP SHALLOW SATURATED ZONE



LEGEND

MW-7	GB-1
SM-2	SS-1
SB-10	SW/SED-1
BG-1	GT-6

GROUND WATER ELEVATION CONTOUR (FT.)

GROUND WATER FLOW DIRECTION

0 120 240

SCALE (IN FEET)

Drawn By GML	ERM®	LUBRIZOL GREINER'S LAGOON SITE FREMONT, OHIO	CHK'D
CADD Review			0004100
Date Drawn/Rev'd 6/1/05		Environmental Resources Management	FIGURE 3

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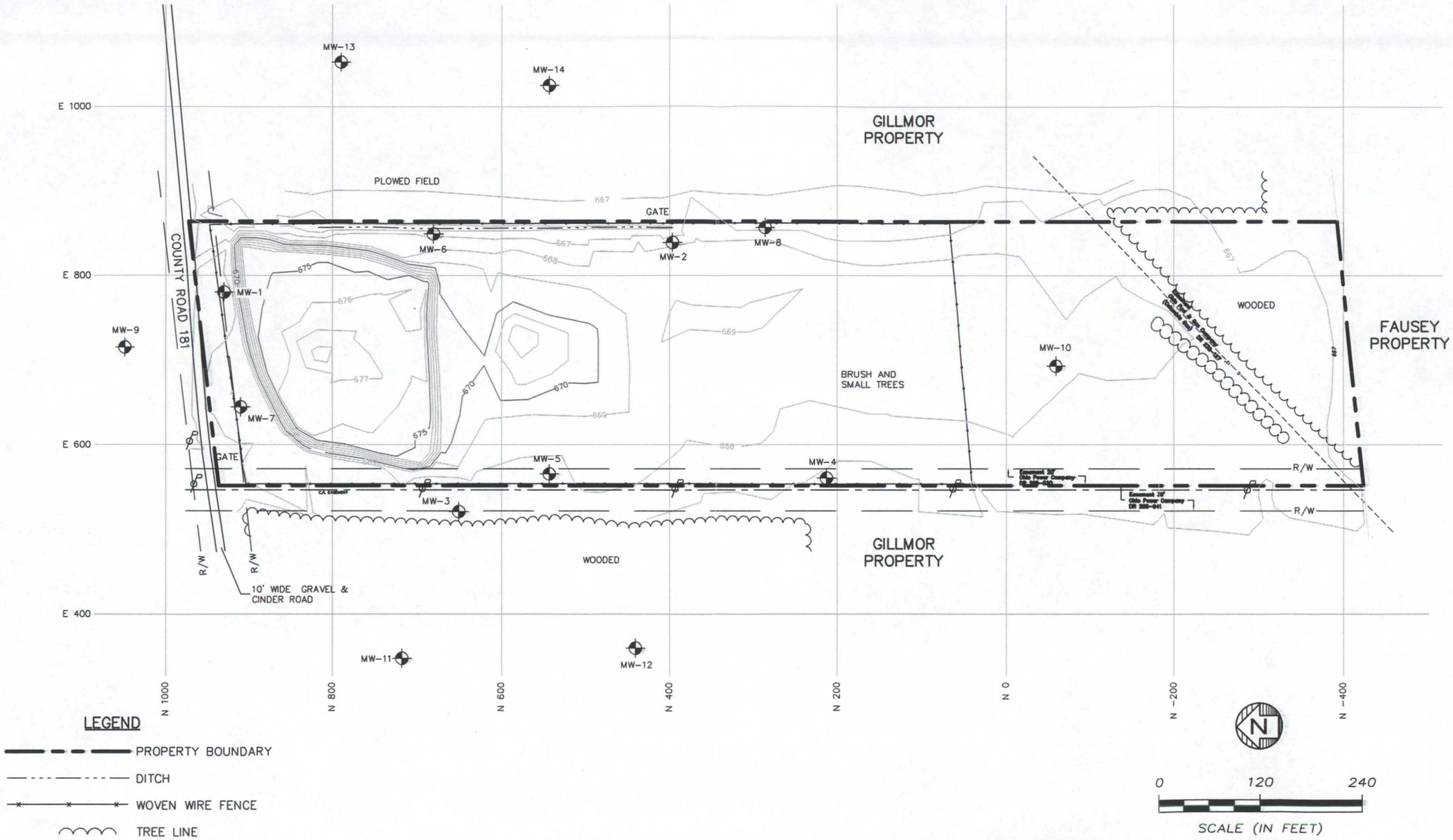
SITEWIDE WELL LOCATION MAP



LEGEND

- PROPERTY BOUNDARY
- DITCH
- WOVEN WIRE FENCE
- TREE LINE
- POWER POLE
- 688 INTERMEDIATE CONTOUR
- 670 INDEX CONTOUR
- MONITORING WELL

Drawn By FAK	ERM	LUBRIZOL GREINER'S LAGOON SITE FREMONT, OHIO	CHK'D
CADD Review			0004100
Date Drawn/Rev'd 6/9/05		Environmental Resources Management	FIGURE 4

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